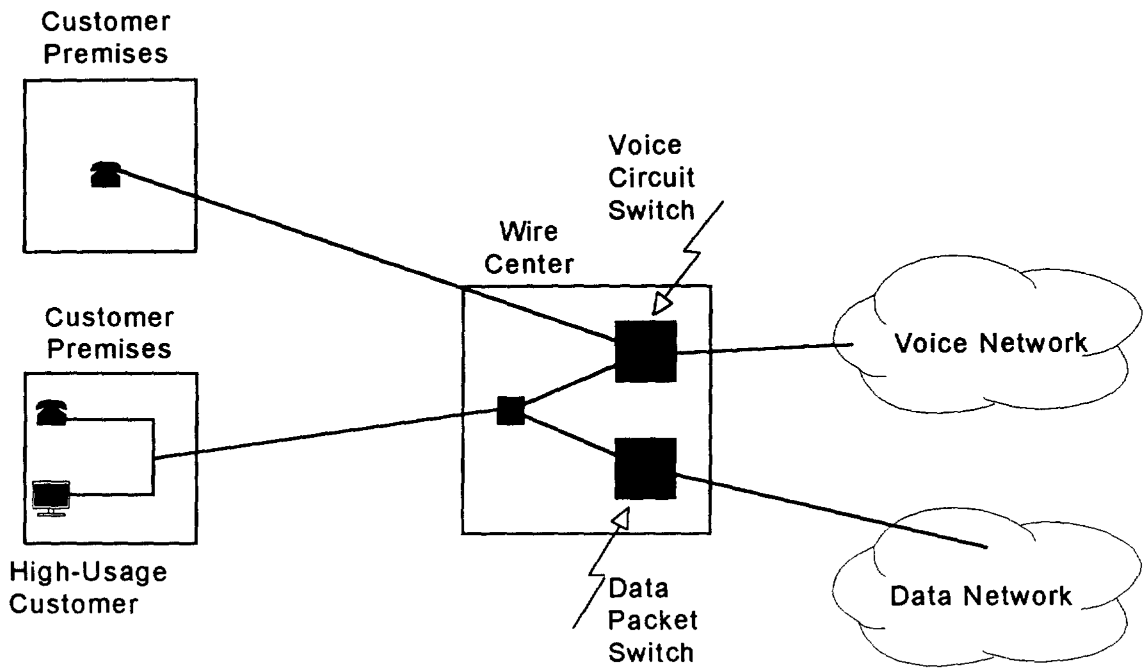

Figure 3A: Nortel Internet Thruway, Generic Arrangement

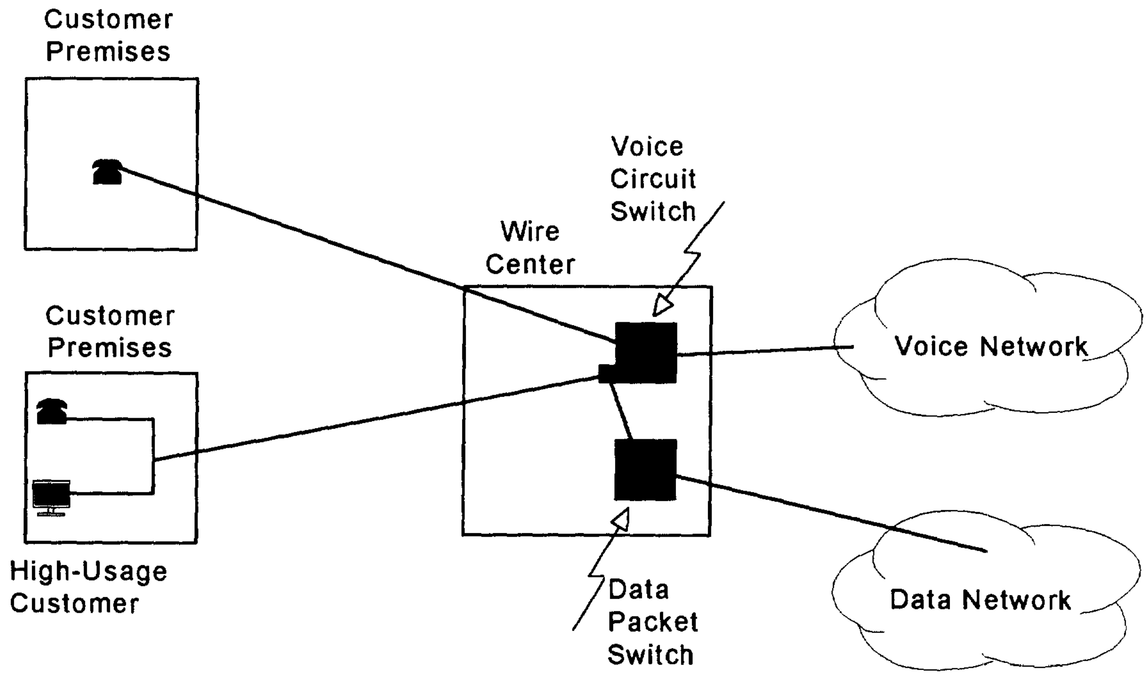

Figure 3B: Lucent Technologies Access Gateway, Generic Arrangement

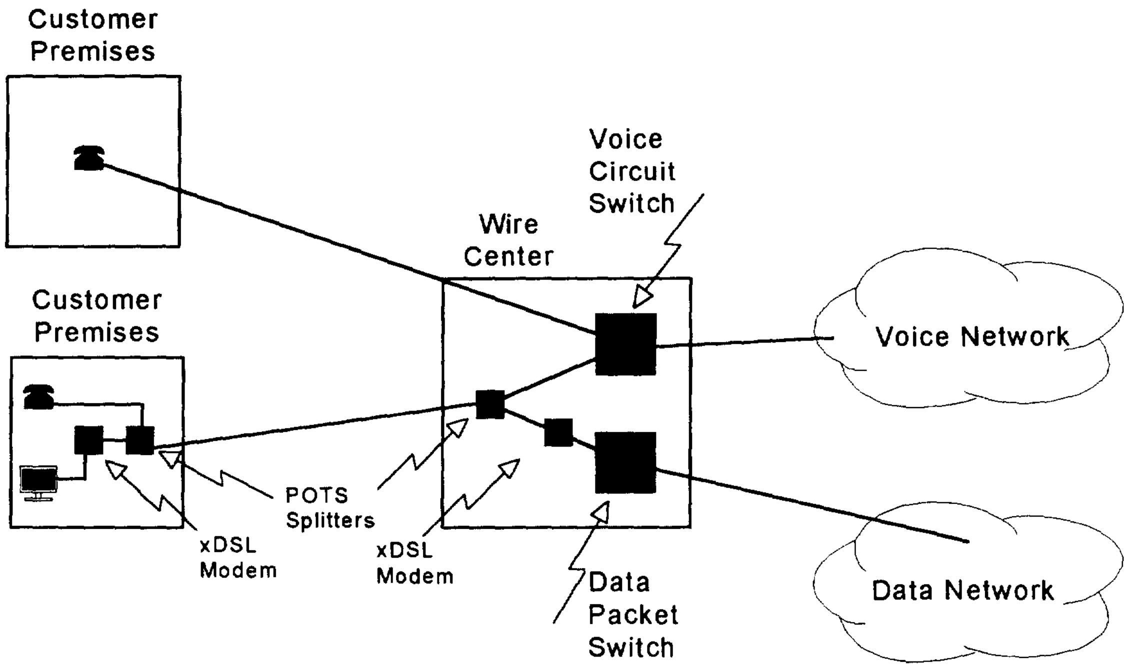

Figure 4: xDSL Technology, Generic Arrangement

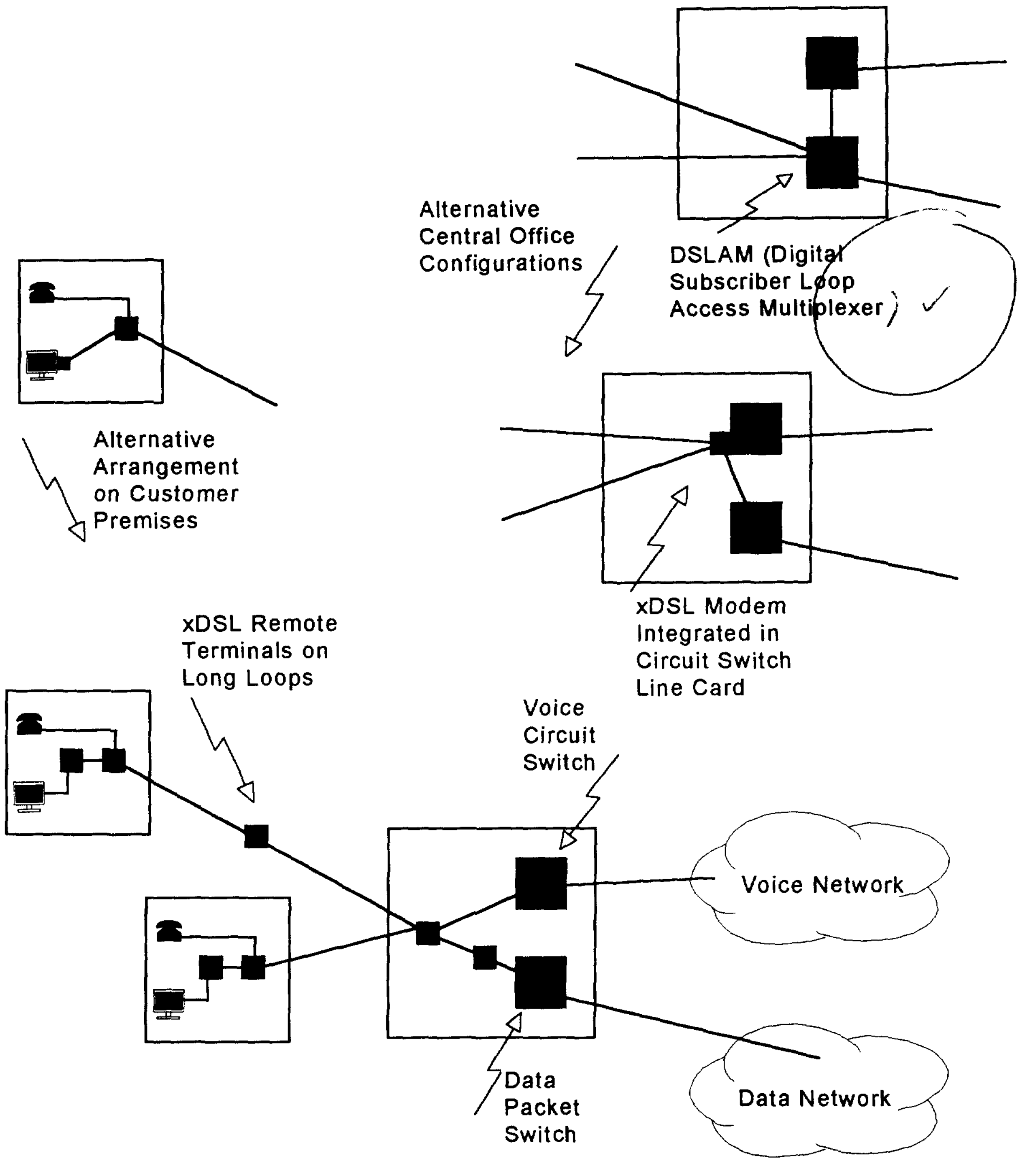

Figure 5: xDSL Technology, Showing Alternative Arrangements on the Customer Premises, in the Loop and in the Central Office

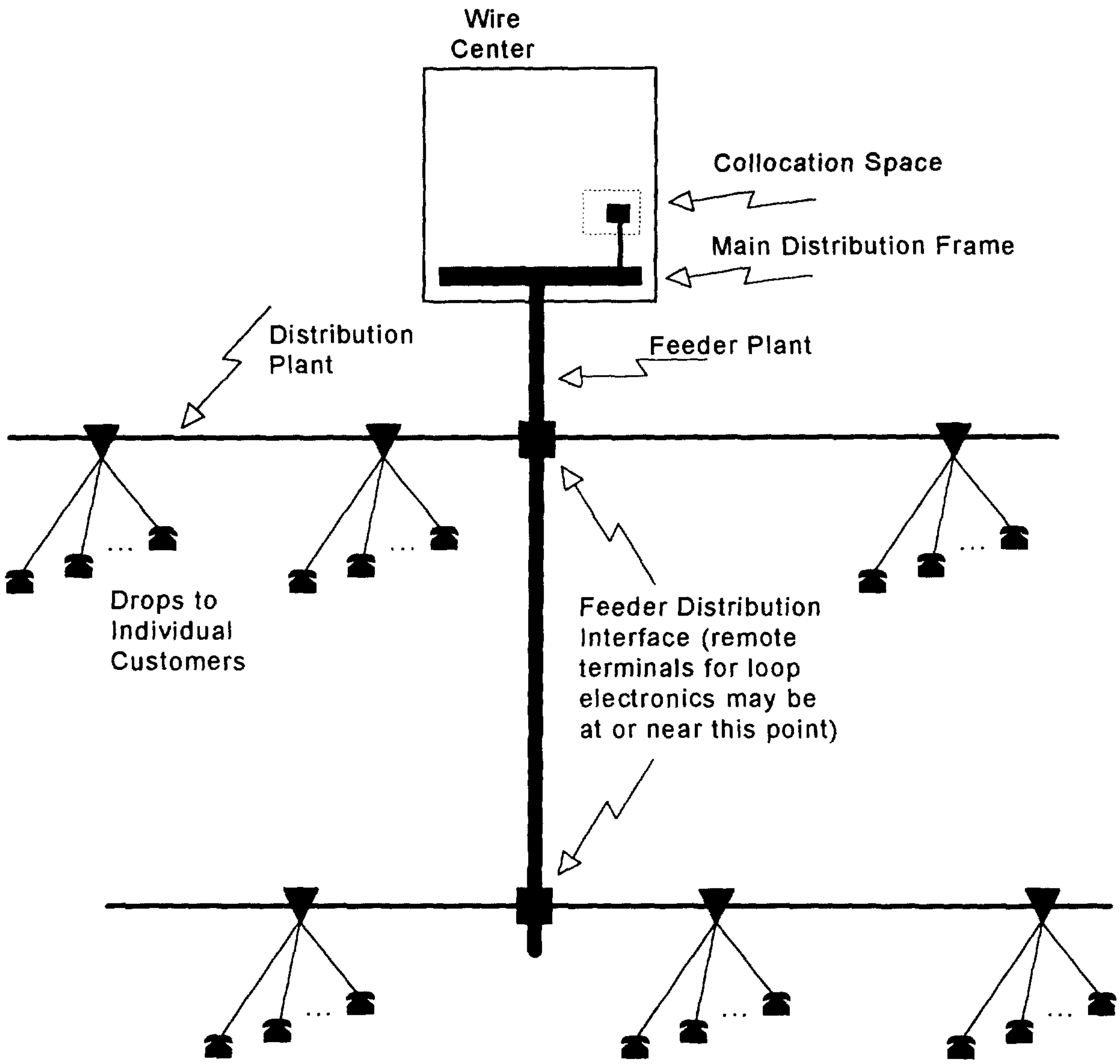

Figure 6: Loop Plant Configuration

B

xDSL Technology	Downstream Data Rate (Mbps)	Apx. Max. Loop Length at this Data Rate (feet)	Apx. Percent of Customers Beyond this Loop Length
SDSL	1.544	10,000	29%
ADSL	8.448	9,000	35%
ADSL	6.312	12,000	21%
ADSL	2.048	16,000	11%
ADSL	1.544	18,000	8%
VDSL	51.84	1,000	94%
VDSL	25.82	3,000	73%
VDSL	12.96	4,500	62%

Table 1: Comparison of Various xDSL Technologies,
Showing Maximum Loop Lengths Without Remote Terminals

Sources: ADSL Forum and Bellcore 1983 BOC Loop Survey

C

THE EFFECT OF INTERNET USE ON THE NATION'S TELEPHONE NETWORK

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The explosive growth of the Internet and online services has generated considerable public discussion about the need for our national communications infrastructure to adapt to emerging technology so that consumers will have affordable access to new interactive services and technologies as they emerge.

At issue is how best to accommodate increased data traffic on local public networks. Before identifying the most appropriate transmission technologies and deployment plans, it is critical to conduct an objective assessment of the current situation, including the impact that the current level of Internet and other online service traffic is actually having on the telephone network.

In making that assessment, this Study concludes:

- Data communications traffic poses no significant threat to network integrity at the present time.
- The increase in data communications traffic has produced additional revenues for the local exchange carriers that far exceed their costs in accommodating that traffic.
- The long-term solution for accommodating increased data traffic lies in the stimulation of competition and in the deployment of appropriate data-friendly network technologies, and not in the imposition of per-minute "access charges" for use of the current voice-oriented circuit-switched network.

Several Bell Operating Companies (BOCs) have recently claimed that the growth of data traffic, mainly calls to Internet Service Providers (ISPs) and other Enhanced Service Providers (ESPs), is clogging the public switched telephone network (PSTN) and is causing service to the public at large to deteriorate. To support these claims, the BOCs and Bellcore, have released studies that purport to quantify the costs and other impacts of ISP/ESP traffic. These studies, however, are not comprehensive assessments of the impact of data traffic on local telephone networks. Rather, they rely on anecdotal evidence drawn from a few unrepresentative central offices, along with some theoretical claims. An examination of these studies reveals that the BOCs' congestion claims are overstated and their assertions that they are inadequately compensated for data traffic ignore substantial revenues attributable to such traffic.

Data communications traffic currently poses no significant threat to network integrity.

The Study concludes that the Public Switched Telephone Network (PSTN) is capable of accommodating the increasing volume of data communications, including Internet traffic, in the near term. The very few congestion problems that have been identified as affecting the telephone network can be easily corrected. Moreover, the study finds that, on average, Internet users do not impose disproportionate costs on local phone networks. Thus, any predictions that Internet traffic will soon result in a "meltdown" of the network are greatly exaggerated.

- The specific areas of congestion identified in the BOC studies are not representative of the nation's 23,686 central office switches, the vast majority of which do not carry much data communications traffic. In fact, the BOC studies focus only on a handful of central offices and switching entities (127) that serve ISPs. This study does not suggest that the specific problems that the BOC studies have identified should not be addressed, but that it is wrong to characterize these *ad hoc* problems as systemic.

- The few PSTN congestion problems that have been identified can be easily corrected. The specific congestion problems identified by the BOC studies are primarily attributable to inadequate planning and/or inefficient engineering, and in any event can be easily addressed and resolved by available service and equipment configurations with little difficulty or cost.

- Any congestion or other problems in the Internet itself, or in a particular ISP's network configuration, pose no cause for concern by the BOCs, since these problems do not significantly affect users of the PSTN.

- The BOCs' own recent efforts to enter the market as ISPs/ESPs undermine their argument that data traffic threatens the PSTN as a whole. If increases in on-line service traffic posed a significant threat to their networks, the BOCs would not be exacerbating the "problem" by offering unlimited Internet access for a flat rate.

The Internet produces net economic gains for local exchange carriers.

The growth of Internet and online service providers has generated significant new revenue streams for local exchange carriers. At the same time, because the heaviest Internet traffic is at non-peak times for the PSTN, this traffic is actually lowering the local telephone companies' per-minute cost of providing service by utilizing capacity that would otherwise lie idle. The Study finds that the Bell companies did not consider these significant economic benefits when they claimed that their infrastructure investments for managing increased data communications traffic are uncompensated. The Study concludes that the recent increase in data communications traffic has generated revenues for local exchange carriers that exceed by a factor of six the incremental costs they incur to carry this traffic.

- Internet users already pay for the local phone services they receive. There is no "free ride" for ISPs/ESPs and their users under the present local rate treatment; local calls placed to ISPs/ESPs are paid for by the calling party and are revenue-producing to the BOC. BOCs receive substantial revenues from users through monthly charges for additional access lines and ISDN lines, and through usage-sensitive fees, as well as from the ISPs/ESPs themselves for the various basic and vertical services and features that they use. This study concludes that, nationally from 1990 through 1995, the local exchange carriers have collected more than $3.5-billion in revenues from additional residential access lines for subscribers who use them solely or primarily for calling ESPs/ISPs.

- In 1995 alone, some 6-million residential subscriber lines were used exclusively or primarily for online access. Total (nationwide) revenues from additional residential access lines whose installation was driven by the subscriber's use of on-line services reached $1.4-billion in that year.

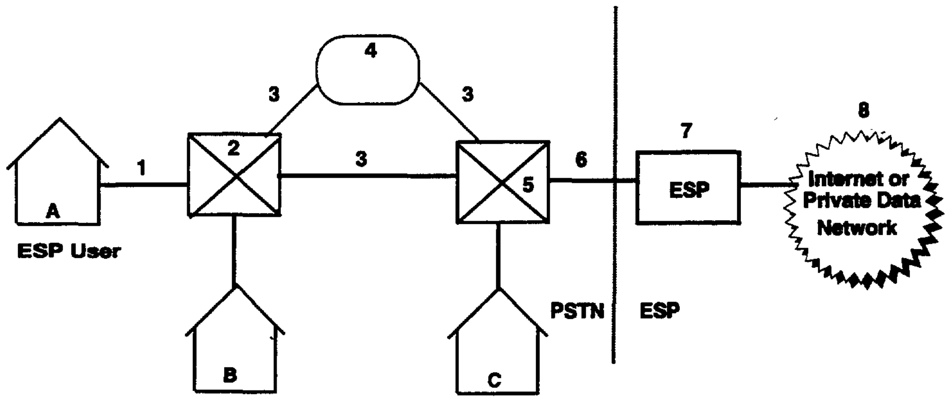
- Compared with the Bellcore study estimate that reinforcing the PSTN will cost some $35-million per year per BOC (for a total of $245-million, nationally), additional residential access line sales stimulated by the growth of on-line services generated revenues that exceed this figure by a factor of six.

The Solution: More Data-Friendly Networks

The Study concludes that the growth of the Internet and other on-line services does not present any immediate congestion or revenue problem for the existing telephone networks. At the same time, it should also be clear that the existing PSTN presents formidable technical impediments to the future growth and development of these new services. Continued reliance upon circuit-switched technology is not a satisfactory solution to the needs of ISPs, ESPs and their customers. The long-term solution for accommodating increased data traffic lies in the stimulation of competition and in the deployment of appropriate data-friendly network technologies, and not in the imposition of access charges for use of the current voice-oriented circuit-switched PSTN.

Congestion internal to the Internet or to ESP Networks does not significantly impact the Public Switched Telephone Network

Local Telephone Network and On-line/Internet Service
Principal PSTN and ESP Elements



Nework Elements

1. **ESP User's subscriber line to end office**
2. **End office (class 5 switch) serving ESP user**
3. **Interoffice trunks**
4. **Local tandem switch**
5. **End office (class 5 switch) serving ESP**
6. **ESP business lines or trunks to end office**
7. **ESP hardware and software**
8. **Internet or private network (backbone, routers, software, servers, etc.)**

This diagram depicts a simplified version of the local telephone network. The public switched network itself consists of Elements *1* through *6*. In considering BOC claims, it is particularly important to bear in mind that any problems associated with lines to a particular ESP (Element *6*); a particular on-line service provider's internal hardware or software (Element *7*); or the Internet or other data network (Element *8*), have no significant impact upon users of the local telephone network.

1 INTRODUCTION

Recent studies issued by four of the Bell Operating Companies (BOCs) and by Bellcore[1] have sought to create the impression, both among industry professionals and the general public, that the explosive growth of the Internet and other on-line services threatens the integrity of the nation's public switched telephone network (PSTN) — and in particular that portion of the PSTN that is owned and managed by the incumbent local exchange carriers (ILECs). These studies purport to demonstrate that data traffic on the PSTN is tying up the ILECs' central office switches, leading to delays in delivering dial tone for other users of the network. The studies further imply that given the massive amount of data traffic they are being forced to handle, the BOCs can only prevent a collapse of the public network by undertaking costly new investments to reinforce and expand the existing, circuit-switched infrastructure,[2] for which, they allege, they will receive no compensatory revenues.

BOC rhetoric on this subject is exemplified by the recent statement by Philip J. Quigley, the Chairman and CEO of Pacific Telesis, who claimed in a speech this past October that the dramatic growth of on-line activity imposes large costs on Pacific Bell in terms of equipment and service, and even threatens a "meltdown in the [local telephone]

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1. *See* "Report of Bell Atlantic on Internet Traffic" (Bell Atlantic study) June 28, 1996; "Pacific Bell ESP Impact Study" (Pacific Bell study), July 2, 1996; Letter from NYNEX to James Schlichting, Chief, Competitive Pricing Division, FCC, dated July 10, 1996 (NYNEX study); "U S West Communications ESP Network Study - Final Results" (U S West Study), October 1, 1996; and Amir Atai, Ph.D. and James Gordon, Ph.D., "Impacts of Internet Traffic on LEC Networks and Switching Systems" (Bellcore study), Red Bank, New Jersey, Bellcore, 1996.

2. In a "circuit-switched" network, an open "connection" is established between the calling and called party for the entire duration of the call, whether or not any information (voice or data) is being transmitted at any particular moment. The alternative to circuit-switched connections is "packet switching," in which no permanent link is established, but information is transported via discrete "packets" of data from its source to its destination. Whereas a circuit-switched architecture occupies resources for the duration of the connection, a "connectionless" packet-switched (e.g., Internet Protocol (IP) based) architecture occupies network resources *only when actual data is being sent.* Hence, while the duration (elapsed time) of a call is a major driver of the costs of a circuit-switched connection, for a packet-switched network the principal cost driver is *volume* of data, irrespective of how much time it takes for a particular quantity of data to be offered for transport over the network.

network."[3] The BOCs' proposed solution for funding the needed expansions and investments is to single out the on-line service providers themselves — Enhanced Service Providers (ESPs) and Internet Service Providers (ISPs)[4] — who use the PSTN to receive communications from their customers' homes and offices.[5] The BOCs argue that as the causers of the growth in data traffic, the ESPs/ISPs should be required to pay the same per-minute "access charge"[6] that the interexchange carriers (IXCs) are required to pay ILECs when they connect end users with their long distance telephone networks.[7]

On its face, the notion that the cost causers should pay for the costs they impose upon local telephone networks is hard to dispute. At issue, however, are the factual underpinnings of this proposition: That users of the Internet and other on-line services are somehow responsible for causing the Bell companies to incur costs *disproportionately higher* than other local telephone network users, and that Internet and on-line service users do not currently pay compensatory rates for the services and network demands that they impose upon the PSTN. As this study will demonstrate, neither of these claims made by the BOCs is valid.

Rather than present a comprehensive assessment of the costs imposed by, and revenues generated from, ISP/ESP use of the public network, the BOC studies address isolated, largely anecdotal and, in any event, unrepresentative situations that they seek to apply inferentially to the public switched network as a whole. The Bellcore study, in contrast, presents a theoretical analysis of the potential impact of increased traffic on the PSTN, as well as a discussion of technological alternatives to circuit-switching. However, it does not demonstrate that its hypothetical results, or the underlying assumptions, accurately reflect conditions in the ILEC networks. Because none of the studies offers a comprehensive

3. Quoted in "PacTel CEO Wants Higher Net Charges," *San Francisco Examiner*, October 4, 1996, at D1.

4. These terms, and others, are used to describe entities that offer on-line computer-based services to end users via telecommunications connectivity. For purposes of this report, the terms Enhanced Services Provider (ESP), Internet Service Provider (ISP), information service provider, and on-line service provider are used synonymously and interchangeably.

5. Currently, most low-volume Internet and on-line service users access their providers by means of ordinary analog voice-type calls placed over the local telephone network. The calls are received at a "modem bank" located at the ISP's premises, where the signals are converted to digital form, and are then packetized and/or multiplexed for transmission to the provider's data network and Internet gateway. From the perspective of the local telephone network, such calls are indistinguishable from ordinary voice telephone traffic.

6. *See, e.g.*, U S West study at 2; Bell Atlantic study at 17; and Pacific Telesis study cover letter.

7. The rules governing federally-tariffed access arrangements are set out in Part 69 of the FCC's Rules (47 CFR § 69). On-line services have been considered end users and thus are not required to obtain access using these arrangements. On-line service providers, like all other end users, obtain service using state-tariffed business lines. See *MTS and WATS Market Structure*, Memorandum Opinion and Order, 97 FCC 2d 682 (1983), at para. 83.

examination of the actual impact of Internet and other data communications use on the public network, they do not support the conclusion that Internet users impose disproportionate costs on the PSTN. Rather, ESP usage patterns, and any costs they impose on the network, are indistinguishable from those of a number of other PSTN applications. Moreover, because all of these studies ignore most of the revenue that Internet and other data communications currently generate for the ILECs, they lend no credence to the claims that such use represents an uncompensated financial drain on ILEC resources. As we demonstrate here, Internet and other data communications service providers do *not* impose costs on the PSTN that differ in any material respect from those imposed by many other large end users. Moreover, while Internet and other data communications providers are not subject to interstate access charge treatment, they currently pay, pursuant to *state* tariffs, rates that are fully compensatory for the services that they use. Finally, ESP customers provide a source of enormous revenues entirely overlooked by the BOCs in their studies.

This report will critically examine the position advanced by the various BOC and Bellcore studies, and offer a more objective perspective on the various concerns that have been raised. This Study's findings are summarized below:

- **Data communications traffic poses no significant threat to network integrity at the present time.** The BOC and Bellcore studies present a distorted picture of the actual impact of data communications traffic by limiting their examinations of the "problem" solely to certain central offices and switching entities that happen to serve ESPs, and even then by assuming (incorrectly) that ESPs in all cases are served in the least efficient manner, from a network engineering standpoint. In fact, data communications traffic, including Internet use by individual residential subscribers, is dissipated throughout the public network and does not constitute a significant proportion of traffic at the overwhelming majority of the nation's 23,686 central office switches. In addition, as the BOCs' own studies confirm, much of this traffic occurs during off-peak periods and thereby uses capacity that would otherwise lie idle.

- **The BOC studies overestimate the costs data traffic imposes on their networks, and overlook the fact that the increase in data communications traffic has produced additional revenues that far exceed the costs of accommodating that traffic.** This Study does not suggest that the specific problems identified in the BOC studies should not be addressed. However, it concludes that the severity of such problems has been overblown. The switch congestion problems that the studies have identified arise because *some* high-use ESP lines are routed through switch components that are designed to handle primarily low-use individual residential and small business access line customers. However, according to the Bell Atlantic study, for example, about half of all ESP lines in its territory are configured so as to bypass these switch components, thereby eliminating dial tone contention and other switch congestion problems.[8] Many other types of high-use lines, such as PBX trunks, are routinely configured for similar "trunk side" connection to the central office switch, for the same reason. Moreover, the BOCs assert that data usage of the PSTN is uncompensated. As this Study will demonstrate, this is clearly untrue. The growth of Internet and other on-line services has stimulated considerable demand for additional residential and business access lines — services that the BOCs themselves are actively marketing, and which they concede are highly profitable. Indeed, this Study's conservative analysis of the revenues generated by additional residential lines used primarily for ESP access indicates that such revenues exceed even the BOC studies' own inflated estimate of the costs they incur from data traffic.

- **The long-term solution for accommodating increased data traffic lies in the stimulation of competition and the deployment of appropriate data-friendly network technologies. The imposition of per-minute "access charges" for the use of the current circuit-switched network is not the "solution" to any "problem" that may exist.** Rather than attempt to deal directly with the specific issues that their studies have identified, the BOCs offer instead as their solution the imposition of duration-based access charges at the ESP end of the data communications call. The BOCs hold that the imposition of a duration-based access charge will somehow relieve the traffic congestion problems at offices that serve ESPs. However, there is no way to ensure that revenues generated from a hypothetical access charge would be used to invest in a network that can accommodate data traffic. Moreover, BOC construction of and investment in such a network should not require access charges at all. In a competitive market, firms finance investments through debt or equity, based upon the anticipation of future revenues generated by new or improved services. Only in situations of monopoly could a firm generate investment funds through increases in prices for services presently offered. In fact, unless their effect is to literally put the ESPs out of business, the presence of access charges will do nothing to address the poor planning and inadequate engineering that are the actual sources of the limited congestion problems that exist. The BOC solution applies a punishment without a cure, and will serve only to stunt the growth of on-line services and enhance the competitiveness of the BOCs' own Internet service offerings at the expense of non-affiliated ISPs. The proper solution for accommodating data traffic is to encourage the development of competition at the local level, enabling new entrants to provide services designed to handle high-speed data traffic efficiently.

8. Bell Atlantic study at 15.

2 NETWORK AND SWITCH ARCHITECTURE

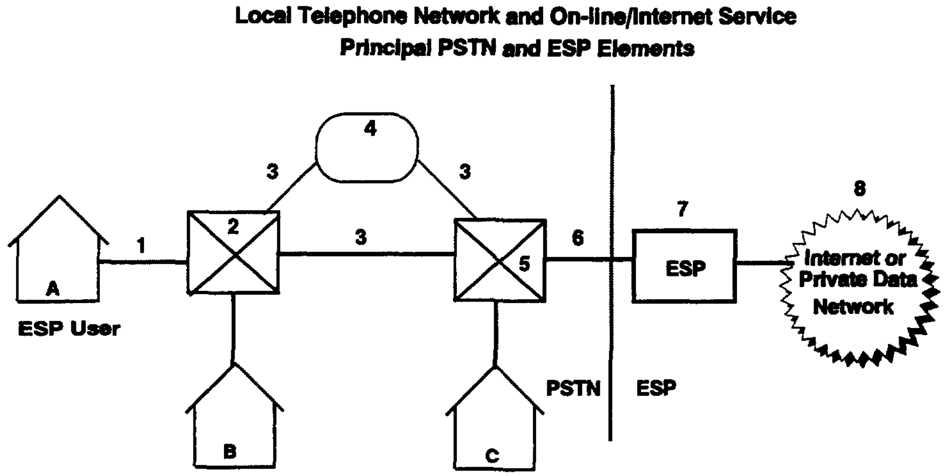
The modern local exchange telephone switching architecture can readily accommodate the limited cases of high-use ISP/ESP activity cited by the BOC studies.

In order to evaluate the actual nature and extent of problems that the BOCs claim to be caused by the usage of the PSTN for data traffic, it is necessary to understand the basic architecture of the modern local exchange switching system. In this section, we describe the switching infrastructure typical of local exchange networks, highlighting especially points of potential congestion in the various network components.

Figure 1 provides an overview of the local telephone network. ESPs and other end users access the public network via *subscriber lines* that connect their respective premises with the LEC central office that serves the subscriber's geographic area.[9] In most cases, there is only one "serving central office" associated with any given customer premises location.[10] The serving central office (also known as an "end office" or "Class 5 switch") is interconnected to the remainder of the local public network via *interoffice trunks* that directly link two end offices or that link an end office with an intermediate switching point known as a "local tandem switch." Generally, when a high volume of traffic between two end offices is present, direct end-office-to-end-office trunking is provided; for lower volume routes and for alternate routing when the high-volume direct trunks are in use, interoffice routing is provided via the tandem. Because large metropolitan areas are usually served by many individual end offices, a substantial fraction of all local calls will typically involve either a direct or a tandem-routed interoffice connection. If the calling and called parties

9. One or more central office switching entities are located in a building often described as a "wire center" because of its function as a point of concentration of subscriber lines from all parts of the geographic area that it serves, together with lines interconnecting the building with other LEC wire centers and with long distance (interexchange) carriers.

10. The incumbent local telephone companies employ a hierarchical architecture that in most cases provides only a single point of connectivity between a subscriber and the PSTN. Other local service providers, such as CAPs, often utilize a "ring" type of architecture in which individual customer premises are provided with at least two separate ways to reach the network.



Nework Elements

1. ESP User's subscriber line to end office
2. End office (class 5 switch) serving ESP user
3. Interoffice trunks
4. Local tandem switch
5. End office (class 5 switch) serving ESP
6. ESP business lines or trunks to end office
7. ESP hardware and software
8. Internet or private network (backbone, routers, software, servers, etc.)

Figure 1. A simplified diagram of a typical local exchange network, highlighting the path of a call from an ESP user to the Internet or other on-line service.

happen both to be served by the same end office, the call can be completed on an *intra-office* basis, requiring fewer network resources than for an interoffice call.

Because an ESP/ISP using an analog connection is simply another end user, a call placed by an end user to the ESP via the current network infrastructure will be routed across the public network in an manner that is indistinguishable from any other local call. Since the ESP/ISP will typically subscribe for a block of individual lines configured in a so-called "hunt group"[11] served out of a single central office, traffic that originates anywhere

11. A hunt group concentrates calls from multiple customers onto a group of lines. In a line hunting arrangement, calls are dialed to a single "listed directory number" (LDN) or "base number," and will be physically routed by the terminating central office to the first available non-busy line in the group. This type of arrangement is quite common, and may be used whenever a customer has more than one exchange access line. Generally, the (continued...)

within the local network will tend to concentrate at the point of termination — the central office that serves the ESP/ISP.[12] Any congestion that may occur is therefore most likely to occur at that terminating central office.

Based on the simplified rendering of the local telephone network architecture presented in Figure 1, there are several specific points where blockage *might* occur between an end user and the Internet or other data network. The BOCs have referred to some or all of these as points of potential or actual blocking — that is, congestion created by the growth of data traffic. In considering potential data network blocking problems in the context of the PSTN, however, one must distinguish between congestion points that might affect other users of the PSTN from those that are specific to a single ESP/ISP or to the Internet, and that are unrelated to the local exchange network.

The originating switch of the ESP user, interoffice trunks, tandem switches, and the terminating switch of the ISP (the network elements labelled *2*, *3*, *4*, and *5* in the diagram) represent the PSTN. Congestion at any of those points might potentially affect the ability of other callers to get dial tone and make and receive telephone calls. Each of these will be examined in greater detail below. Usage of the distribution segment between the ESP customer and its serving central office (the element labelled *1* in Figure 1) has no impact on any user of the PSTN, except for the ESP customer. The element labelled *6*, that is, the link between the ESP and its serving end office is also distinct from other network elements in that congestion here will generally arise only where the ISP has failed to order a sufficient quantity of lines for the number of customers it has in a given locality. This type of congestion will not typically affect *other* users of the PSTN, unless they attempt to call the ESP.[13] Elements *7* and *8* involve hardware and software internal to the ISP and traffic

11. (...continued)
number of lines required for a particular customer will depend heavily upon the total volume of traffic that the entire group of lines is intended to carry. Such groups are typically engineered on the basis of the number of calls blocked per 100 attempts, sometimes referred to as the "grade of service" for the line or trunk configuration. Holding "grade of service" (e.g., the probability of 1 busy signal per 100 attempts ("P.01")) constant, the larger the group (number of lines), the higher will be the peak utilization per line in the group. For a discussion of the traffic engineering properties of line hunting groups, see R.F. Rey, Technical Editor, *Engineering and Operations in the Bell System*, Second Edition, Murray Hill, NJ, AT&T Bell Laboratories, 1983, Chapter 5, and Mischa Schwartz, *Telecommunication Networks*, Reading, MA, Addison-Wesley, 1987, Chapter 10.

12. The BOC/Bellcore ESP/ISP impact studies limited their examinations and measurement solely to the particular end offices that serve ESPs, thereby obtaining a "worst case" picture of the relative impact of ESP/ISP traffic. For other end offices that do not serve ESPs/ISPs (which were excluded from the BOC/Bellcore studies), the data portion of total traffic handled by the end office will in the vast majority of cases be *de minimis*.

13. This is particularly so where a common channel signalling architecture, such as Common Channel Signalling System 7 (SS7), is present, as it is in most (soon to be all) ILEC networks and end office switches. When a call is placed in an SS7 network, the status of the called number (i.e., busy or idle) is determined before the routing of the
(continued...)

and infrastructure internal to the data network. *Any congestion at these points is clearly separate from the local exchange network, and any indirect costs that such congestion might impose on the PSTN are minimal or nonexistent.*

Blockage problems that *could* impact the PSTN can therefore occur at only three network points (Elements *2*, *3* and *5*). If sufficient numbers of ISP customers (represented by *A*) are served by a single end office switch (Element *2*), all paths through the switch could be blocked by their calls to the ISP, preventing any additional users (represented by *B*) from placing or receiving calls. In general, interoffice trunks (Element *3*) are provisioned in such a way that several paths exist between any two central offices (directly and via a tandem switch (Element *4*) in the example), and blocking problems should not occur. That is, any customer that can place a call at the originating switch will have an interoffice trunk available that can establish a route to the desired terminating switch of the call. However, it is conceivable that all paths between two central offices, or between a tandem switch and an end office, might be in use with no alternatives available in rare cases when interoffice trunks are underprovisioned or where a sudden or unanticipated increase in traffic volume occurs.[14] Finally, the switch that *terminates* calls to an ISP (Element *5*) might also be blocked by calls to the ISP. A sufficiently large number of calls passing through the switch and terminating on standard analog lines can cause blocking on the switch, preventing customers at *C* from placing and receiving calls.

13. (...continued)
call is set up. If it is determined that the called number is in use (e.g., because the ISP did not order a sufficient number of lines), the calling party receives a busy signal *generated by the originating end office*, and no use of interoffice network resources is required. Prior to the deployment of common channel signalling, the status of the called number could not be determined until the call itself had been set up. Thus, whereas in the past a customer's failure to provide adequate capacity could "back up" into the public network, this will not be the case in modern SS7-based infrastructures.

14. ILECs may, on occasion, encounter an unanticipated increase in interoffice usage over certain routes, either in the form of a short-lived spike or a permanent change in the overall volume of traffic. Neither of these conditions are unique to ISP/ESP services, and may arise with respect to any number of end user applications. As noted in footnote 13 *supra*, the ubiquitous presence of SS7 works to minimize the operational impact of temporary spikes, permitting calls that cannot be completed (due to trunk congestion) to be blocked at the originating switch. In cases of a permanent increase in traffic volumes, the additional revenues resulting from the increased usage as well as increased demand for additional residential access lines will typically be more than sufficient to defray the costs that the ILEC might incur in expanding interoffice capacity. Most local usage charges fall in the range of 2 to 3 cents per minute both for measured and flat-rate service, to the extent that flat-rate charges are set based upon average usage characteristics, whereas the proxy costs for local interoffice switching and transport, as identified in the FCC's *Interconnection Order I* in CC Docket 96-98, amount to between 0.4 and 1.05 cents per minute (consisting of a 0.2 to 0.4 cent local switching component at each end, plus a 0.15 cent tandem switching component (in the small fraction of cases where tandem switching is required), and less than 0.10 cents for local transport, where required). As these proxy costs were developed for average traffic conditions, the figures above will tend to overstate the actual costs of Internet calls, given that the majority of Internet usage takes place during off-peak, late evening hours. *See First Interconnection Order*, CC Docket 96-98, at para. 822, footnotes 1949 and 1959, and para. 824.